

Cryogenic Fluid Management Technology Development Roadmaps

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Advancement in Cryogenic Fluid Management (CFM) Technologies is essential for achieving NASA's future long duration missions. Propulsion systems utilizing cryogenics are necessary to achieve mission success. Current State Of the Art (SOA) CFM technologies enable cryogenic propellants to be stored for several hours. However, some envisioned mission architectures require cryogenics to be stored for two years or longer.

The fundamental roles of CFM technologies are long term storage of cryogenics, propellant tank pressure control and propellant delivery. In the presence of heat, the cryogenics will "boil-off" over time resulting in excessive pressure buildup, off-nominal propellant conditions, and propellant loss. To achieve long term storage and tank pressure control, the CFM elements will intercept and/or remove any heat from the propulsion system. All functions are required to perform both with and without the presence of a gravitational field. Which CFM technologies are required is a function of the cryogenics used, mission architecture, vehicle design and propellant tank size.

To enable NASA's crewed mission to the Martian surface, a total of seventeen CFM technologies have been identified to support an In-Space Stage and a Lander/Ascent Vehicle. Recognizing that FY2020 includes a Decision Point regarding the In-Space Stage Architecture, a set of CFM Technology Development Roadmaps have been created identifying the current Technology Readiness Level (TRL) of each element, current technology "gaps", and existing technology development efforts. The roadmaps include a methodical approach and schedule to achieve a flight demonstration in FY2023, hence maturing CFM technologies to TRL 7 for infusion into the In-Space Stage Preliminary Design.